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EDITORIAL

Our Great Traditions

WHEN we undertook to visit half-a-dozen chemical laboratories we confess that we expected to be greatly interested but we were in fact both surprised and impressed. These visits and the many visits that we have paid to other laboratories in previous years have convinced us that our chemical laboratories are truly carrying on the fine traditions which we of this generation have received from our distinguished teachers in the past. We are practising to-day the most modern methods of research, with the zeal, the patience, and the accuracy which in old days distinguished our most gifted workers; we are not only practising these but we are teaching the rising generation to adopt those laborious and methodical methods of study which are necessary to a thorough comprehension of the theories of the science and the practice of the art. We consider that if such lovers of accuracy as Cavendish, Lavoisier, Stas, and Richards, or such great pioneers as Liebig, Hofmann, Dumas, Davy, and Faraday could come amongst us now they would be proud and glad that their careful and truthful methods, their desire to get a clearer insight into the changes of matter they watched, and their willingness to live laborious days in the service of science still persist and still impel our scientific workers to advance steadily from one discovery to another. The research work carried on in our ancient universities fills us with just pride; our modern universities cannot all of them entice, by an adequate but usually small salary, by the charm of buildings with a few centuries of happy life behind them, and by a social atmosphere of peace and refinement, those who are among the Olympians on the banks of the Isis or Cam, but they do attract first-rate workers, they build excellent laboratories, they equip them with the best appliances, and they publish a considerable volume of first-rate work that has greatly enlarged our chemical knowledge. Our industrial laboratories have not all of them enjoyed the generous treatment bestowed on those we describe in this issue but in the course of the last twenty years we have visited the labs in many works and factories and without any hesitation we affirm that the same spirit pervades them all, the spirit of thoroughness and truth. We have been intimately acquainted with industrial chemical research for more than a score of years and are quite satisfied that our industrial chemists, like our academic ones, have that infinite capacity for taking pains and that determination to overcome obstacles that were characteristic of the early chemists who set up our high standards. We are confident that these traditions are firmly imbedded in our scientific character. The young chemist has a hard task; he has much to learn and his hours are often long; this is true also of young lawyers, young accountants, young skaters, and young musicians, and of life generally; but our young chemists will from their environment gradually acquire the doggedness and zeal that will enable them in time to do easily what is at first a laborious task. We have the utmost faith in the rising generation; and what we have stated of chemistry we believe to be true of the other natural sciences.

The world has inherited other great traditions and we believe that these are a permanent part of our modern civilization: many of these traditions depend on that common factor of performing the task in the best possible way. In literature there have always been and possibly there always will be fashions and those from time to time shirk the hard work of careful writing; but in general the fashion that involves slackness does not last long and we come back in prose to accuracy in the use of words to describe our mental picture, and in poetry to such attainment of the sublime and the beautiful as we are capable of. Many modern readers scoff at the old-fashioned romances of Scott and Thackeray: but these have a steady sale and will endure longer than some of our present-day best sellers. There are, we feel sure, traditions in painting, music, architecture; we have not studied these so as to justify us in writing of them, but we are satisfied that great and noble traditions exist and although some of our gifted modern young people rebel against the old we have a sort of conviction that such rebellions do not last very long nor effect very much and that fifty years hence Bach and Beethoven, and Van Eyck and Vermeer, and Andrea del Sarto, and Dürer, and Botticelli, and Corot, and Corelli, and Purcell, and many others of the old masters will still have a good reputation. And what of our other great traditions that belong to our modern civilization: our respect for justice, our love of truth and of freedom, our tolerance for those who differ from us in religion, in race, or in politics, our desire to work in sympathy and understanding with all who wish to see this world better and happier? Every now and then there will be a rebellion against the traditional old-fashioned ideas, but we think these rebellions also will not last very long nor effect very much; if there are in any countries men of science, or literature, or

art, who are at the moment placed in situations of difficulty or hardship, it is perfectly true that they may experience for some time that which they find difficult to justify or endure, but we cannot believe that our great standards of morals will be permanently torn up and destroyed. There have been difficult times before in many centuries; there is a difficult time now and there will be others in the future, for intolerance is not extinct in any country; but on the whole we think we shall return in this respect also to those great traditions which have in many countries been most highly valued by those best able to judge.

Industrial Organization

Prof. G. C. Allen has recently written a book entitled "British Industries and their Organization," in which his main purposes are to consider the condition of representative British industries since the war, and to describe their present organization. Of its kind, it is a most fascinating book: crammed with facts, it nevertheless reflects their pre-digestion and gives the impression of personal first-hand knowledge of the situations and conditions discussed. The author first makes a preliminary survey of British industry before 1914, and illustrates the changes which the nineteenth century saw in the geographical distribution of economic activities according as areas could or could not well adapt themselves to the new conditions. An observation of general application, one which is especially pertinent at the present time, attracted our attention on one of the earliest pages. "Whenever a change in technique or organization occurs," declares Prof. Allen, "the older seat of an industry always has difficulty in maintaining its position. It clings to the processes and methods which have brought it success in the past. Its competitors are not handicapped by this inertia." Now this is a sweeping statement which, probably, has in the past been substantially true, and still contains in it enough truth to constitute a warning and exhortation. We are, in fact, never too old to learn, and those who think they know all about an industry most need to make sure about its future. The author proceeds to discuss the coal industry, and shows that not until 1927 was it free from the abnormal influences of temporary demands and subsidies, and left to find its place in the post-war world. Referring to the development of methods of utilizing all the constituents of coal he remarks that, on the whole, the cheapness and high quality of British coal in the past produced wasteful methods of utilization which are difficult to abandon now that economy has become important, whilst on the Continent, the original dearness of coal led to economical methods of utilization, and these are more suited to the present circumstances. The rise and position of the iron and steel industry is another subject brought under review. Here again the historical survey "shows that a position of apparently unchallengeable supremacy may be undermined in a short space of time by technical changes which destroy the relative advantages of some producing areas and confer leadership on others." Of the former, "its plant is rendered obsolete and its personnel, bred to the older methods, has difficulty in adjusting itself to the new." The main difficulties of the iron and steel trade are considered to be international in character, and the future of the British fraction of it appear to depend on whether bulk products or specialities are to be its chief products. The motor trade, in view of its great influence on social and economic life, is naturally examined in some detail, and this chapter will interest those who drive as well as those who make. In his final chapter Prof. Allen discusses changes which have in the last decade taken place in the structure of industry, referring to increased instability of demand as one of the chief causes of industrial depression, and remarking, in the case of the growing chemical industry, on the obvious advantages to be secured from large-scale research and production.

Ascorbic Acid

The river of chemical progress flows always onwards casting up this and that positive achievement on its banks. The latest natural compound to have its constitutional formula determined and to be synthesized is ascorbic acid. This success has been achieved by a team of workers captained by Prof. Haworth, who, in football parlance, has become an accomplished goal shooter. The synthesis in itself has not been difficult to accomplish, but it possesses very special interest on account of the association of ascorbic acid with vitamin-*C* largely established by the researches of a Hungarian, Prof. Szent Györgyi, who was the first to show that the active principle of this vitamin was of the nature of a considerably modified uronic acid. The analytical work of Hirst and others in the Birmingham laboratories revealed the groups associated with each carbon and made it possible to suggest a formula, viz., 3-keto gulofuranolactone for the substance. It has been synthesized in the laboratory, starting from *l*-xylose, though in the plant it is more probable that it originates from glucose. The chemists have prepared a crystalline analogue of ascorbic acid from glucose also which is to be tested physiologically, and no doubt other similar substances can be made synthetically differing only slightly in stereochemical configuration so that it will be possible once again to obtain evidence of the influence of such small changes on physiological activity. We need not recall here the far-reaching importance of vitamin-*C* and of the fact that it has been synthesized and will be obtainable in quantity, and that other substances like it are available for testing and may be of value in elucidating the manner of its action. Equally interesting is the association of vitamin activity with a sugar derivative and with a substance which is a powerful reducing agent, though of course it is not by any means established that ascorbic acid is the only antiscorbutic agent. In biological oxidation systems, ascorbic acid, which is present in relatively large amounts in normal adrenal cortical tissue, inhibits the formation of pigment. Preliminary accounts of these syntheses have been communicated already to our columns so that our readers have been kept in touch with their progress: this is proving to be a year of many happenings in the domain of biochemistry; there come periods in science when the final results of long continued researches crystallize out.

ALFRED NOBEL'S INVENTIVE GENIUS*

By JEROME B. BELL

This year, 1933, is the one hundredth anniversary of the birth of Alfred Bernhard Nobel, inventor of dynamite, and founder of the Nobel Trust Fund.

According to his will one-fifth of the interest from his estate was to be awarded as a prize "to the person who has done the most effective work to promote friendship between nations, and to secure the elimination or reduction of standing armies, as well as for the formation and popularization of peace congresses," and it may seem inconsistent that a man who spent a lifetime advancing the science of explosives should have been a pacifist. I hope to bring out the fact that Nobel's chief efforts were given to the development of commercial explosives, and that it was only in the later years of his life, after he was possessed of a great fortune, that his active mind could not resist tackling the unanswered problems in the field of propellants.

The genius that was Alfred Nobel's did not make its appearance in the family until the advent of Immanuel Nobel junior, the father of Alfred, although his ancestors were obviously unusually talented, for among them were to be a found a musician, a lawyer, an artist, a surgeon, and an architect and engineer; certainly a fine record for a family of peasant origin.

Immanuel junior, the father of Alfred, was born in 1801, and received a meagre education. He eventually became a student-architect, and later studied engineering. In 1829 he set up in Stockholm as an inventor, but soon became busily engaged as an architect and engineer, apparently on construction. In 1837 he went to Finland, and shortly afterward to St. Petersburg, where he was joined by his family in 1842. His activities here were directed almost exclusively along military and naval lines. He returned to Sweden with his wife and youngest son, Emil, in 1856 and busied himself with inventions, many of which were of a fantastic nature.

Alfred Nobel was the third of four boys, and he and his older brothers remained in St. Petersburg when their parents returned to Sweden. Robert, the oldest brother, continued to work in the Nobel St. Petersburg factory, then practised architecture, manufactured fireproof brick, and started a lamp oil business in Finland. On the failure of this last, he joined Alfred as business manager, and later joined Ludwig's business in St. Petersburg.

Ludwig wound up the Nobel affairs in Russia, and then went into the manufactnre of rifles etc. on a large scale. This business took Robert to Baku, where he renewed his interest in the oil industry. In 1875 these two brothers entered this field and within ten years were unquestioned leaders. They invented new refining methods, introduced tankers, tank trucks, and storage dumps, built a model village, endowed schools and a technical college, and encouraged employees to invest in the firm. Apparently Alfred supplied some part of the capital for the commencement of this vast enterprise, and as the business man of the family, furnished both capital and financial advice at various times. This industry continued to prosper until the revolution put an end to the company's activities.

Alfred was educated with his older brothers. Following a term or two in a preparatory school in Sweden, he was placed under tutors in St. Petersburg, until he was sixteen or seventeen, and the next three or four years were spent in travel. During this time he met a number of engineers and scientists, among them John Ericsson, and Prof. Pelouze of Paris; the latter may have first interested him in nitroglycerine. He then worked in various capacities for his father until the collapse of the Russian enterprise and his father's return to Sweden.

One of his father's fruitless experiments after his departure from Russia involved the addition of nitroglycerine to ordinary black powder. Prof. Sinin of St. Petersburg had also directed Nobel's attention to nitroglycerine, and it is a matter of debate therefore whether Pelouze, Immanuel Nobel, or Sinin should receive the credit for turning Alfred Nobel's genius to the problem of finding a method for releasing at will the enormous energy locked up in this compound.

Nobel made three great contributions to the explosives industry, and the first of these was in 1862, when he succeeded in exploding nitroglycerine. The explosive character of this compound had, of course, been recognized by Sobrero and others, but Nobel's discovery of a method of exploding the material safely and surely and at will, placed this new source of power at the service of the world. His original method of accomplishing this seems to have been by using a priming charge of black powder which was immersed in the vial or tube of nitroglycerine.

At this time, or very shortly afterwards, Nobel conceived the idea of propagation of an explosion wave, and abandoned the old idea that it was necessary to raise the temperature of the whole body of an explosive to the explosion point. With priming caps in common use it was then a comparatively short time before Nobel had arrived at the fulminate detonator as we know it to-day.

The manufacture of nitroglycerine was begun and, following the explosion, in the experimental plant, which cost Emil Nobel and four others their lives, the first commercial scale plant was erected in Sweden in 1864. As a concession to public opinion, this plant was located for a short time on a pontoon anchored in a lake a few miles from Stockholm. Other factories were erected, and in 1866 a Nobel plant in Hamburg began the export of nitroglycerine, and the expansion of the companies was rapid.

At this time little was known of the properties of this explosive and the idea was current that it was more or less harmless. The product was quite impure and frequently somewhat acid. This acidity is easily correctable and we can only suppose that careless manufacturing processes were the outcome of the casually accepted idea of the safety of the product. In justice to Nobel it should be stated that the industry at this time was expanding at such a rate that he was concentrating his efforts on the business features and leaving the manufacturing end to others.

Naturally there were many disasters, and restrictions began to threaten the new industry. France and

* Delivered before the Montreal Section on October 4, 1933.

Belgium prohibited manufacture or possession, Sweden prohibited transport, most other countries prohibited movement by rail, and England imposed such regulations as almost amounted to total prohibition. Nobel's next problem was obvious. Having found out how to explode nitroglycerine, he had now to find out how to prevent it from doing so until desired.

Attempts were first made to render the nitroglycerine insensitive by solution in some non-explosive solvent such as methyl alcohol. After transportation the alcohol was washed out with water, leaving the explosive ready for use. Patents were taken out to cover this process and some of the more conservative, or obstinate, miners continued to demand their explosives in this form long after the problem had been solved in a better and cheaper way. It is worth noting that nitroglycerine is still transported in solution in very small amounts for special uses. But Nobel recognized that a method which required processing at the point of use was undesirable however simple the operation might be. Exhaustive experiments were then made with absorbents such as wood shavings, charcoal, and kieselguhr. The chemical stability of kieselguhr, together with its high power of absorption, decided the question, and the resulting invention was dynamite. Nobel's safety powder, as it was called, was his second great achievement in the science of high explosives. The English patents were obtained in 1867 and seven years later the total annual sales were more than three thousand tons.

This discovery was much more important than even Nobel at first realized. It changed the whole picture of explosive operations, as well as solving the original problem of safe transportation. Canal and tunnel projects which had been dreams before that time became definite possibilities, and the economic life of mines became, to all intents and purposes, doubled or trebled overnight.

There is a widely believed story that the discovery of dynamite was due to the accidental leakage of nitroglycerine into kieselguhr which had been used as a packing for the explosive containers. I can do no better than quote parts of a letter of Nobel's giving the early history of the discovery.

Nobel states, "I made and exploded the first dynamite—without a detonator but under strong confinement—towards the end of 1863. It consisted of nitroglycerine absorbed in porous charcoal, about two parts of the former to one of the latter." After stating that he covered the idea by patents, he continues, "At that time I was not aware of the great porosity of kieselguhr, which came under my notice only a few months later." Further on he says, "I certainly never noticed on any occasion an accidental leakage of nitroglycerine into the kieselguhr packing in such quantity as to form a plastic or even moist material, and the idea of such an occurrence must have been originated formerly by some one who took a guess for a certainty. What brought my attention to the use of guhr for dynamite was its great bulkiness when dried, which, of course, testified to great porosity."

Nobel continues, "It may appear strange at this distance of time that dynamite, though substantially originated and experimented with on a small scale as early as 1863, should have been brought out for use only in 1866. But please bear in mind that liquid nitrogl erine had not yet proved unmanageable, that dynam to become perfect, needed the use of detonators of spe kind, and that I had to face the difficulty of displa a strong explosive—nitroglycerine, by a weak one dynamite. Hence the temporary necessity to ren liquid nitroglycerine available for the benefit of thos and they were numerous—who would insist on us nothing but the liquid explosive. This led to r schemes of adding methylic alcohol, and also of washi the nitroglycerine out of dynamite. The latter me however, was never practically worked at all."

It is apparent from his letter that the mining fratern of the time believed "the stronger the better" whe came to an explosive. This is not the case to-day ar rating pure nitroglycerine at 100, there is now probab more 40% explosive used than there is of all ot strengths combined.

Once the principle of absorbents had been establish the road for further experiment was clearly indicat and Nobel and his associates were responsible for a gr part of the progress made. So-called "active dope made their appearance and dynamites began to con of a queer mixture of substances. Kieselguhr w given an honourable discharge in most countries abo the turn of the century.

"Dope," I may explain, is a term used in the indust to represent the mixture of the non-explosive (or least non-readily-explosive) ingredients of a mix explosive. "Active" dopes are those which, unli kieselguhr, undergo some change (usually a chemic change which converts them to the gaseous state) the detonation of the mixed explosive.

It is difficult to trace the exact development of t active dope dynamites. Kieselguhr had obvious d advantages in that it was a diluent of the explosi agent nitroglycerine and contributed nothing to t reaction on detonation of the dynamite. Probab sawdust or wood pulp next came into use, and saltpet shortly afterward to furnish the necessary oxygen f their complete combustion. As early as 1867 Nol acquired the rights to "an explosive consisting ammonium nitrate and sawdust, powdered charco or some similar substance, together with an organ nitrate compound." While nothing was apparent done with this discovery for a long time, the so-call "ammonia dynamites" now have an enormous sa far surpassing the "regular" or N.G. dynamites.

Nobel was however still trying to satisfy the tra by giving them an explosive safe in transport and u and of a strength equal to, or approaching that of, th liquid nitroglycerine to which they had been accu tomed. The search was apparently a lengthy one, i what practically amounted to a world-wide ban on liqu nitroglycerine came in force about 1866 and success w not attained until 1875 when he discovered "blastin gelatin," a colloidal solution of nitrocellulose in nitr glycerine. This is the third of the three great contri butions made by Alfred Nobel to the scientific manufa ture of commercial high explosives. Like many anoth discovery, blasting gelatin was soon to enter other fiel than that for which it was developed. To-day th

demand for high strength gelatins is much less than for those of low strength. Nitrated cellulose products had been known long before this time. In 1833 Braconnot dissolved cellulose in strong nitric acid and obtained a product which he named xyloidin, and which was soluble in ether alcohol. Pelouze in 1837 obtained a somewhat similar product but managed to retain the fibrous structure of the cellulose. Under certain circumstances he discovered that a product insoluble in alcohol was formed, and this he named pyroxylin. In 1845 Schönbein made guncotton by treating cotton wool with a mixture of nitric and sulphuric acids.

It must be realized that black powder was still the only propellant and nitrated cellulose had such obvious possibilities that chemists and research workers all over Europe engaged themselves in the study of its manufacture, properties, and uses. As with nitroglycerine however, methods of purification were crude, disaster followed disaster, and the interest began to lag. Sir Frederick Abel, then chemist of the British War Department, became interested, and by patience and ingenuity succeeded in stabilizing this new explosive. He reduced the violence of the action somewhat by pressing the material into blocks, but it was still found too fast for use as a propellant. Abel made guncotton and associated products his life work, and he and Nobel were antagonistic for some years by reason of their violent advocacy of their respective favourites. Eventually the two were reconciled as happily as were nitroglycerine and guncotton after the invention of cordite and smokeless powders.

The discovery of blasting gelatin, like that of dynamite, is also ascribed in technical literature to the workings of chance. Nobel, however, repudiates this story and asserts that he had experimented with nitroglycerine–guncotton mixtures long before the discovery of blasting gelatin. The early experiments were a failure since he failed to secure a solution of suitable consistency.

Sohlman and Schuck's biography of Nobel furnishes a concise account of the discovery. I ask your permission to quote these authors:

"One day when working in the laboratory he (Nobel) cut his finger and applied collodion to the wound. The pain in his finger kept him awake at night, and he lay pondering over the problem which was always in his thoughts—how to find a suitable means of combining guncotton with nitroglycerine. He hit upon the idea that this might possibly be done more successfully with nitrocellulose which was less highly nitrated than with such a substance as the collodion which he had just used. He went down to his laboratory at four o'clock in the morning, and when his assistant, Fehrenbach, arrived at the usual time, Nobel was able to show him the first specimen of blasting gelatin which he had produced in a flat glass vessel. It consisted of nitroglycerine with the addition of a small proportion of a solution of nitrocellulose in ether alcohol."

The problem was still far from solved. The type of cotton, the degree of nitration, the equipment for and the methods of gelatinization had still to be worked out. To answer the second of these questions Nobel carried out over two hundred and fifty laboratory nitrations, many of which had to be repeated on a plant scale later. Active dopes were soon being experimented with in gelatinized explosives. Wood pulp, sodium nitrate, and ammonium nitrate began to take on importance as ingredients, and commercial high explosives, essentially as they are to-day, were ready to the user's hand.

A brief summary of Nobel's discoveries in the field of propellants will not be amiss, since these are really more or less direct results of his discovery of blasting gelatin. Guncotton had long had its advocates as a propellant, but even Abel's outstanding work had not succeeded in taming this explosive. In 1887 Nobel patented a smokeless powder which he named ballistite, and which consisted of equal parts of nitroglycerine and nitrocellulose with 10% of camphor. This explosive was adopted for military purposes by several European countries. It was the first of a number of propellants to demonstrate the property, not of "exploding" but of burning progressively from layer to layer at a uniform rate, which depended of course on the pressure. Heretofore propellants had been such that the pressure behind a projectile decreased as the projectile approached the muzzle of the gun. With ballistite the progressive burning nullified this fall in pressure to a considerable extent, and projectile velocities and ranges thus secured were much greater than those possible with former explosives. Nobel collaborated with Abel and Dewar in eliminating certain objections that the British Explosives Commission had to ballistite. At the instance of the two Englishmen, experiments were made with a highly-nitrated "insoluble" nitrocotton, and cordite came into being. This explosive contained 58% of nitroglycerine, 37% guncotton, and 5% petroleum jelly. Gelatinization was effected through the medium of a solvent, acetone, which was eliminated by drying after manufacture. The explosive was so called from the cord-like form in which it was used. The British Government did not allow Nobel's claims to this discovery, and Nobel broke off his association with Abel and Dewar.

To the layman, as well as to those of us whose interests lie in things explosive, *Nobel* means *Explosives*: it is somewhat surprising then to see among the several hundred patents credited to Nobel:—A Gasometer; Methods for Improving the Production of Sulphuric Acid; A Device Against Fire in Buildings; Method for the Production of Cyanides; Armour Plating; Artificial Silk; Artificial Rubber; Devices for Phonographs, Telephones and Electric Batteries; Artificial Leather; Incandescent Mantles, and a Method for Aerial Mapping.

It is remarkable that Nobel, with most of the responsibility of a gigantic organization on his shoulders, should have had time to devote to such a miscellany of subjects, and almost as remarkable to note how his work prophesied many of the major developments of the twentieth century.

During the last five years the annual consumption of commercial high explosives in the British Isles was 34,700,000 lb., in the United States 415,000,000 lb., and in Canada 41,500,000 lb.

I am told that one pound of explosive yields five tons of coal, three and a half tons of stone, or three and a

quarter tons of ore—some indications of what explosives, correctly applied, are accomplishing in Canada.

Alfred Nobel was a genius, and those in the industry owe him a great debt, but that debt is no greater than is owed by the humblest citizen of any civilized country. There is hardly an article of modern commerce which explosives have not put within the financial reach of the man-in-the-street. Nobel's discoveries must be accorded a leading place in the list of great inventions.

SOME CONSIDERATIONS CONCERNING THE MECHANISM OF EXPLOSIVE COMBUSTION OF GASEOUS HYDROCARBONS*

By ALFRED W. FRANCIS

Prof. W. A. Bone recently delivered the Bakerian Lecture on "The Combustion of Hydrocarbons"[1] which is a review of the work of his laboratory on the mechanism of combustion. He presented evidence in support of the hydroxylation theory of combustion as opposed to a "peroxidation" theory or a preferential combustion theory. Most of his positive evidence was drawn necessarily from the results of slow combustion in which intermediate oxidation products can be isolated; and for this type of combustion he has made a good case for his theory.

The conditions for explosive combustion of hydrocarbons are so different from those for slow combustion however, being many thousands of times more rapid and at several hundred degrees higher temperature, that it is by no means certain that the same mechanism is followed in both cases. Moreover, in the experiments which he and his co-workers made with explosions in order to obtain evidence for this type of combustion, although the observations were undoubtedly correct, some of the conclusions seem to me not entirely justified. These conclusions have been presented by him and his co-workers previously,[2, 3, 4, 5a] apparently without any question of their validity. So extensive and brilliant a research as that carried on in his laboratory should be discussed widely as to interpretation.

An alternative mechanism for explosive combustion is that advanced by Misteli,[9] namely, that decomposition of hydrocarbons to the elements precedes reaction with oxygen. This theory might possibly hold for acetylene or even for ethylene, which are explosive alone under certain conditions; but cannot be true for most other hydrocarbons, which are exothermic and so are not explosive alone.

A modification however of Misteli's idea is so simple and explains the observations so well that it is probably subconsciously in the minds of many persons familiar with the facts. This is that part of the hydrocarbon is burned furnishing sufficient heat to decompose another part to its elements, which in presence of additional oxygen may then be burned separately, partially, or completely, depending upon the excess of oxygen, the temperature, and the pressure. This theory accounts more satisfactorily for substantial yields of elementary carbon resulting from the explosion of certain rich mixtures.

* Abstracted from a portion of a thesis submitted to the Worcester Polytechnic Institute, Mass. in 1929 in partial fulfilment of the requirements for the degree of Chemical Engineer.

As opposed to the mechanism suggested by Misteli, which Bone considers incompatible with the hydr oxylation theory, the latter with Drugman propos and performed[2] certain "crucial experiments." Mix tures corresponding to $C_2H_6 + O_2$, $C_2H_4 + H_2 + O_2$, an $C_2H_2 + 2H_2 + O_2$, all of which have the same ele mentary composition, were exploded separately, and th products compared. Those from the latter two explo sions were almost exclusively carbon monoxide an hydrogen, whereas the ethane mixture produced als considerable carbon and steam as well as some carbo dioxide and methane. It was concluded (*a*) that th preliminary partial decomposition theory is untenabl because the three explosions did not give the sam products: and (*b*) that the affinities of ethylene an acetylene for oxygen in flames far exceed that o hydrogen.

Neither conclusion is warranted. (*a*) Although the have the same elementary composition, the thre mixtures are not equivalent. The ethane mixture i much lower in energy content than the others, th (theoretical) heat of hydrogenation (about 30,600 cal.)[1] of ethylene being already lost. The heat of combustio of ethane is less than that of ethylene plus hydrogen o acetylene plus hydrogen, so that the flame temperatur is much lower in this case than in the other two. rough estimate of the flame temperatures, based upo the heats of combustion and heat capacities of th products, gives for the ethane mixture 900° C., for th ethylene mixture 1400° C., and for the acetylene mixtur 2200° C. At the higher temperatures of the latter tw explosions, the carbon (before it has a chance to separat reacts with the steam completely so that no carbon an very little steam remain in the combustion products.

The equilibrium can be computed thermodynamicall for the equation

$$C + H_2O \rightleftharpoons CO + H_2.$$

Using the most recent and presumably the most accurat calculations, those of Chipman,[6] the free energy of th reaction [by combining his equations (5) and (8 is $\Delta F = +30,050 - 4{\cdot}8\ T\ln T + 0{\cdot}003T^2 - 2 \times 10^{-7}T^3 - 1{\cdot}27T$
from which the equilibrium constants and calculate yields of carbon or steam at the suggested flame tem peratures are as follows:

Temperature	900° C.	1400° C.	2200° C.
$K = \frac{P_{CO} \times P_{H_2}}{P_{H_2O}}$	24	1450	29,000
Yield of C or H_2O	10·5%	0·2%	0·01%

The rapid shift of the equilibrium to the right wit disappearance of carbon and steam at higher tempera tures is evident.

If the ethane mixture could have been preheated t an appropriate temperature, which would have to b about 1000° C. in order to supply to the mixture th same energy contained in the ethylene mixture at roo temperature, the result would have been the same a in the other cases. No carbon and practically no stea would have been deposited.

Although such an experiment is impracticable, th reverse result, namely, the production of large quantiti of both carbon and steam from the explosions of eith ethylene or acetylene with oxygen, has been accon

...ished by Bone and his co-workers,[4a, 5b] by the present author, by Venable,[10] and probably by others. All *that is necessary is to use a mixture of* hydrocarbon and oxygen or air close to the upper limit of inflammability (*as was the ethane mixture* in Bone and Drugman's crucial experiment). The excess of hydrocarbon by its *high heat capacity* keeps the flame temperature low and allows an equilibrium in the flame favourable to the formation of some carbon and steam rather than exclusively carbon monoxide and hydrogen. The nature of the products of a hydrocarbon explosion is determined primarily by the flame temperature, which in turn depends upon the composition of the explosive mixture with respect to the inflammability limits, being lowest near those limits. The limits themselves are determined by the energy involved, being wide when heat of combustion is high.

Another respect in which the three gas mixtures were not equivalent is in their densities. Since all three were exploded at about the same pressures and since the numbers of moles were two, three, and four respectively, the densities varied in inverse proportion. However, this distinction is slight in effect as compared with the differences in energy content.

Before discussing conclusion (*b*), namely that the affinities of ethylene and acetylene for oxygen in flames far exceed that of hydrogen, let us consider the extension of it *by Bone and his co-workers*[3, 4b] to include methane, in which methane and hydrogen were made to *compete in an explosion for a limited amount of oxygen.* When mixtures of the composition $CH_4 + O_2 + 2H_2$ were exploded at high pressures, only 3% to 5% of the methane remained unconsumed. The same observation was made when a mixture, $CH_4 + O_2 + 2CO$ was exploded. Since "methane got by far the lion's share of the oxygen," they concluded that its affinity was twenty to thirty times stronger than that of hydrogen (or carbon monoxide) for oxygen in explosion flames."

Now the method of competition experiments is a favourite one with me, especially for extremely rapid reactions; and I have published several papers[8] which employ it. It has been used legitimately to compare rates of combustion of olefins in explosions;[7] but it cannot be used properly when both reactions are reversible, or when the reaction products can react with each other or with the competitors.[8b] Thus the observations upon the explosion of $CH_4 + O_2 + 2H_2$ can be explained equally well by the successive reactions (*a*) and (*b*):

$$2H_2 + O_2 \rightarrow 2H_2O \qquad (a)$$
$$H_2O + CH_4 \rightarrow 3H_2 + CO \qquad (b)$$
$$\overline{O_2 + CH_4 \rightarrow H_2O + CO + H_2 \qquad (c)}$$

whose summation (*c*) is identical with that postulated by Bone. The temperature of the explosion flame is ample to bring about reaction (*b*), so that the observation is a result of an equilibrium and not that of relative rates of combustion.

Indeed the low temperature preferential combustion of free hydrogen or carbon monoxide in presence of hydrocarbons in gas analysis by means of copper oxide,[12] (initial combustion points with CuO: hydrogen, 175—180° C.; carbon monoxide, 100—105° C.; ethylene, 315—325° C.; methane, above 455° C.), or catalytically with atmospheric oxygen by means of palladium suggests that reaction (*a*) proceeds initially almost to the exclusion of (*c*) in explosions of such mixtures, although such reasoning from the results of slow combustion is subject to the same criticism as is Bone's evidence for the hydroxylation theory from similar slow combustions. The view is supported further, however, by observations of Coward and Dixon,[2] who gave for instantaneous ignition in air the following ignition temperatures: hydrogen, 631° C.; carbon monoxide, 696° C.; methane, 725° C.

The same reasoning applies to the "competitions" for oxygen between methane and carbon monoxide, and between hydrogen and ethylene or acetylene. Results of competitions in explosions involving as competitors hydrogen, carbon monoxide, or methane, all of which may be regenerated[1c] by equilibrium reactions, are without significance as to relative rates of combustion or relative affinities for oxygen. Prof. Bone has recognized,[1a, 4b, 5d] the possibility of subsequent equilibrium reactions in explosions although he ignores their vitiating effect upon his conclusions at this point.

The principal objection to the hydroxylation theory as applied to flame combustion is its failure to account *satisfactorily for the presence in the flame of free carbon.* This is especially true in the combustion of methane *since the initial reaction product according to Bone is* methanol.[1b] As methanol cannot be decomposed *directly to give free carbon,*[5e] *it is improbable that the* carbon found in hydrocarbon flames could arise from decomposition of nascent methanol, as claimed by Bone[1c] and by Bone and Townend.[5f] The presence of carbon in flames might be explained by the idea of preferential combustion of hydrogen *i.e.*, the singeing off of hydrogen from the hydrocarbon molecule, but this idea was disproved easily by Bone[1] by citing numerous experiments in which carbon monoxide and hydrogen were almost the exclusive products. The carbon must result therefore from thermal decomposition of part of the original hydrocarbon, the necessary heat being supplied by combustion of another part of it. While this simple mechanism thus probably explains the bulk of the reactions in such explosions, the presence of traces of aldehyde in the products indicates to a small degree some other form of addition of oxygen to the molecule, which may be hydroxylation.

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NOTES ON MR. FRANCIS' PAPER

By PROF. W. A. BONE

While many facts could be cited against Mr. Francis's view that in explosive combustion "part of the hydrocarbon is burnt furnishing sufficient heat to decompose another part into its elements, which in presence of additional oxygen may then be burned separately, partially, or completely, depending on the excess of oxygen, the temperature and the pressure," it may, perhaps, suffice for me to say that the results of the $C_2H_2 + 2H_2 + O_2$ explosion to which he refers are unaffected by (*a*) considerable changes of initial pressure, such as (say) between 250 and 750 mm., (*b*) dilution of the medium with its own volume of either argon or helium, which would of course considerably reduce the flame-temperature, or (*c*) dilution with hydrogen up to about $C_2H_2 + 4H_2 + O_2$. Moreover, the results of photographic analyses of acetylene-electrolytic gas—$xC_2H_2 + y(2H_2 + O_2)$—and of $C_2H_2 + O_2$ explosions (Bone, Fraser, and Lake, *Proc. Roy. Soc.*, **A, 131**, pp. 1—17) are quite incompatible with such view, which is also countered by spectrographic evidence.

It may also be pointed out that the results of my $C_2H_6 + O_2$ explosions (which he also cited) disagree with Mr. Francis' calculation that the yield of C or H_2O *should be* 10·5%; *for, when such were carried out* in a sealed bulb at an initial pressure of 746 mm., 16% of the original carbon was deposited as such and 36% of the original oxygen appeared as steam. Moreover, neither the comparative results of exploding such mixture in (*a*) a long cylinder and (*b*) a large globe (*J.C.S.*, 1906, **89**, p. 1617, and "Flame and Combustion in Gases," p. 391) nor yet those of its "detonation" in a lead coil—when the flame speed was 2180 m. per second and the mean temperature would probably be of the order of 3000° C.—support his thesis. In the last-named case, both steam condensed and carbon was deposited, the ratio p_2/p_1 was 1·90, and the gaseous products contained CO_2 = 1·8%, CO = 39·1%, C_2H_2 and C_2H_4 = 1·4%, CH_4 = 7·7%, and H_2 = 50·0%. Indeed it was such result that finally convinced the late H. B. Dixon that (as he wrote me) "the main reaction taking place in the 'explosion wave' is . . . $C_2H_6 + O_2 = CH_3{\cdot}CHO$ with $CH_3{\cdot}CHO = CH_4 + CO$," *i.e.*, in accordance with the hydroxylation theory. Yet Mr. Francis presumes that if it were practicable to raise the temperature of the $C_2H_6 + O_2$ to that of the $C_2H_4 + O_2$ reaction, the end results would be alike, which *in fact they are not*.

The hydroxylation theory of hydrocarbon combustion outlined in my Bakerian Lecture, as well as in the lecture which I gave on October 19 last to the Chemical Society in London, is based on the cumulative results of more than forty years' experimental study of the subject under all conditions ranging from slow flameless combustion, through flames, up to explosions at high pressures, including detonations, and comprising some hundreds (indeed I might even say thousands) of experiments, in course of which not only chemical, but also photographic and spectroscopic analyses have been employed. The evidence has been considered as a whole, as well as in detail, and the theory put forward because it seems best to co-ordinate and express the facts. And whatever may be thought of it, at any rate one has at least acquired enough "horse sense" about the subject to know that its complexities are not likely to be resolved by such facile thermodynamical calculations as Mr. Francis has attempted. Indeed such considerations as he suggests have all along been kept in mind, but the experimental evidence has never seemed to substantiate them.

Nowhere in my published papers has it ever been claimed (as he implies) that $C_2H_6 + O_2$, $C_2H_4 + H_2 + O_2$ and $C_2H_2 + 2H_2 + O_2$ mixtures are "equivalent" in every particular; but only that, inasmuch as they contain "the same relative proportions of gaseous carbon, hydrogen, and oxygen," their explosions might be used as a means of testing the supposition, advanced by Misteli in 1905, that, *before undergoing combustion* in flames, hydrocarbons are wholly resolved into their elements, the carbon then being burnt preferentially. And in considering the results the differences between their mean flame temperatures were not overlooked.

Moreover, I have always recognized the occurrence of such secondary reversible reactions as $C + OH_2 \rightleftharpoons CO + H_2$ and $CO + OH_2 \rightleftharpoons CO_2 + H_2$ during the cooling periods in such explosions: seeing, however, that the final equilibria attained do not correspond with the mean *maximum flame temperatures but (as I have shown)* with some much lower temperature at which equilibrium in each case "freezes out," Mr. Francis's argument re maximum flame temperatures seems to me beside the mark.

In my $CH_4 + O_2 + xH_2$ explosions, where no carbon was ever deposited, although x was increased to 8, the percentage of the original methane unburnt was calculated from the ratio which the surviving methane bore to the total $CO_2 + CO + CH_4$ in the final products, and therefore the calculations depended only on the accuracy of the final gas analyses. In this connexion readers are referred to Chapter XIX of "Gaseous Combustion at High Pressure" (Bone, Townend, and Newitt, 1929).

While concluding from my numerous experiments, as I think rightly, that the mutual affinity between oxygen and a gaseous hydrocarbon **X** is overwhelmingly greater than that between oxygen and hydrogen (or carbonic oxide) in flames, I have repeatedly shown how, when in excess, the hydrogen influences the oxygen-distribution according to its active mass, however little it may get when present only in the $X + O_2 + H_2$ proportion.

I fail to see what bearing the preferential burning of hydrogen or carbonic oxide in heterogeneous catalytic combustion can be supposed to have on homogeneous explosive combustion; nor yet how Dixon and Coward's determinations of the instantaneous "ignition temperatures" of hydrogen (681°), carbonic oxide (696°) and methane (725°) support Mr. Francis' views. As, however, he considers they do, he ought not to have selected one instance favouring (according to *his* reasoning) his case and ignored others contradicting it; for while the "ignition range" of methane may be higher, those of other hydrocarbons (*e.g.*, ethane, propane, ethylene, and acetylene) are lower than that of either hydrogen or carbonic oxide in air. Moreover, whatever crumb of

..fort he may imagine to derive from his contemplation methane in such connexion vanishes in the light of ..on's determinations of ignition temperatures under ..abatic compression; for methane–oxygen mixtures .. were all found to be much lower than those of ..rogen–oxygen mixtures ("Flame and Combustion ..ases," pp. 76—77). Also Mr. Francis might turn .. contemplative mind to W. M. Thornton's observa..ns (1916) that the electrical ignition of an equi..ecular methane–hydrogen mixture in air follows that methane in air, which he regarded not only as "a ..iking confirmation of Bone's measurement of the ..tive affinities of methane and hydrogen," but as ..wing further "that they hold in the very earliest ..ge of explosion" (Proc. Roy. Soc., **A, 92**, pp. 398—9). ..tention may also be directed to Townend and ..ndlekar's recent remarkable discoveries regarding the ..fluence of pressure upon the spontaneous ignition of ..drocarbon–air mixtures which fall in line with the ..droxylation theory. Their work on butane–air mix..res was published three months ago (Proc. Roy. Soc., **141**, pp. 484—93) and a further instalment on ..ntane–air mixture is now in the press.

There is no difficulty at all in satisfactorily accounting .. the presence of free carbon in hydrocarbon explosion..ames on the basis of the hydroxylation theory, since ..rbon would or might result from such possible thermal ..ompositions as:

$$CH_3OH \rightarrow \begin{cases} :CH_2 + HOH \\ :CH + H + HOH \\ :C: + 2H + HOH \text{ etc.} \end{cases}$$

$$C_2H_5OH \rightarrow \begin{cases} 2:CH_2 + HOH \\ 2:CH + 2H + HOH \\ 2:C: + 4H + HOH \text{ etc.} \end{cases}$$

$$CH_3{\cdot}CHO \begin{cases} CH_4 + CO \\ {\cdot}CH_3 + H + CO \\ :CH_2 + 2H + CO \\ :CH + 3H + CO \\ :C: + 4H + CO \text{ etc.} \end{cases}$$

The separation of carbon during pressure-explosions of methane–oxygen media containing less methane than $3CH_4 + O_2$ has been so fully dealt with in Chapter XVIII of "Gaseous Combustion at High Pressures" (q.v.) that no more need be said about it here. After all, those who have actually made such experiments are, perhaps, best qualified to pass judgment on their results.

So overwhelmingly great is the mutual affinity between hydrocarbon and oxygen in flames that whenever the combustible is hydrocarbon only and enough free oxygen is present to reduce it to the mon- or di-hydroxy stage, such oxidation will, I believe, take precedence over its thermal decomposition. Hence any carbon liberated in such circumstances would much more likely arise from the subsequent decomposition of an oxygenated molecule (*e.g.*, alcohol or aldehyde) so formed than from that of the original hydrocarbon itself. Albeit, in circumstances where hydrocarbon molecules cannot get at oxygen—because of either the latter's deficiency or the presence in mass of other competing combustible gas—some of them may undergo thermal decomposition with ultimate separation of carbon, though this may be suppressed if there be sufficient hydrogen available in the medium to hydrogenize $:CH_2$ and $:CH$ radicals to methane. This is well shown in pressure-explosions of $C_2H_4 + O_2 + xH_2$ mixtures where progressive increments in x between 2 to 8 caused increasing steam and methane formation without any carbon deposition at all (*vide* Phil. Trans., **A, 215**, pp. 308—310, and "Gaseous Combustion at High Pressures," pp. 307—8).

London
Nov. 2, 1933

THE VITAMIN-*B* COMPLEX

The twenty-third Bedson Lecture, entitled "Some Recent Aspects of the Vitamin-*B* Complex," was delivered by Prof. R. A. Peters, Whitley Professor of Biochemistry, Oxford University, at Armstrong College, Newcastle-upon-Tyne, on November 3.

The water-soluble *B* group of vitamins, discovered originally as the food-factor missing in cases of beri-beri, has now been fractionated into six distinct vitamins, one of which is necessary for health in both birds and mammals (B_1), but requires to be supplemented by B_3 and B_5 in the former, and by B_2 and B_4 in the latter case. Vitamin-B_1 has been concentrated after long series of experiments to fractions showing ever greater potency (as shown by their curative action on polyneuritic birds) until crystals were obtained by Van Veen and others, using rice polishings as the source, and by Windaus, and also by Dr. Peters and his collaborators using yeast. The process finally evolved consists of water extraction, adsorption on Fuller's earth, or on charcoal, at varying p_H values, and in the process devised by Dr. Peters, of fractional precipitation as phosphotungstates from a solution of which the p_H value is slowly altered. After a final purification of the gold salts, this yields about 17 mg. of crystalline material per cwt. of yeast. The formula deduced for the material from rice polishings was $C_{12}H_{18}O_2N_4S$, but that from yeast is significantly richer in carbon and sulphur. Factors B_2 and B_4 have also been greatly concentrated. It has been shown that the physiological actions of the vitamins are in relation to the oxidase sytems of the brain, appearing in isolated tissue cultures to be concerned with the oxidation of lactate, but not of succinate, and accelerating or maintaining the former only in the presence of pyrophosphate. The evidence is not yet quite clear, and in some cases the observed facts are difficult to reconcile. There is some suggestion that vitamin-B_4 may be a pentoside, possibly of neucleotide type; the crystals of it so far obtained appear to be as much as 80%—90% adenine. There is a further possibility that vitamin-B_2 may be a flavine.

THE USES OF COKE-OVEN GAS

A short article appeared recently* in *Die Naturwissenschaften* outlining the uses of coke-oven gas in Germany. The points mentioned are of interest to all industrial chemists, and are therefore summarized here.

One cb. m. of coke-oven gas furnishes 0·175 kg. of methane, 0·05 kg. of hydrogen, 0·062 kg. carbon monoxide, and 0·025 kg. of ethylene. Formerly, the most important constituent was hydrogen, which was

* F. Rosendahl, Naturwiss, 1933, 21, 501–502.

obtained from coke-oven gas for use in the Haber process, but more recently many other uses have been found for hydrogen and for the other gases. The separation of hydrogen from coke-oven gas is carried out in Germany by freeing the purified gas from carbon dioxide by washing it first with water at a pressure of 10—25 atmospheres, and finally with caustic soda solution. On cooling by the counter-current principle, the hydrocarbons ethane, ethylene, and methane are separated. There are still present carbon monoxide, nitrogen, and hydrogen. If pure hydrogen is required, the carbon monoxide and nitrogen are liquefied by intense cooling and pressure, and the hydrogen passes on in the gaseous state. If the gas is required for the Haber process, the nitrogen may be left, the carbon monoxide only being removed by passing through liquid nitrogen, and if the temperature at which the separation is effected is carefully adjusted it is possible to secure a mixture of nitrogen and hydrogen in the required proportion of 1 : 3.

At one time this was the only outlet for the hydrogen of coke-oven gas, but there is now so much coke-oven gas made that all the hydrogen is not absorbed by the *synthetic ammonia industry. The older uses, such as* for the oxy-hydrogen blowpipe and for the hardening of oils and fats, do not use much of the gas. Other technical hydrogenations have however been perfected.

The hydrogenation of carbon monoxide to methyl alcohol by passing the mixture under a pressure of 200 atmospheres over a catalyst (zinc oxide, with chromium trioxide as a promoter, is suitable) at 300—400° is a reaction of importance, which is in the hands of I. G. Farbenindustrie. The hydrogenation of carbon monoxide may lead to the synthetic production of petroleum hydrocarbons under proper conditions. This is a very interesting catalytic process, which has been perfected by Fischer and Tropsch. According to Sabatier and Senderens, a mixture of carbon monoxide and hydrogen passed over nickel at 300° gives methane, but Fischer and Tropsch, in their work on contact catalysts, have found that this mixture passed over iron at 200° yields petroleum hydrocarbons, the reaction proceeding first to an intermediate stage, after which condensation takes place, leading to the formation of the higher hydrocarbons. The type of hydrocarbon mixture formed depends on the proportion of hydrogen in the original mixture. The less hydrogen there is, and the more carbon monoxide, the more saturated is the hydrocarbon *mixture* produced, the best composition of initial gas being one part of carbon monoxide to two of hydrogen. In water gas the ratio is one to one, but a good mixture can be obtained from coke-oven gas. If the latter is passed with steam over pieces of clay heated to 1000°, the methane undergoes decomposition according to the equation

$$CH_4 + H_2O = CO + 3H_2$$

thus providing a hydrogen-rich gas. The process is being carried out in Germany by the Ruhrchemie A.-G.

Methane itself has several uses. It has been suggested that it would prove a very economical fuel for heavy motor lorries. Besides the fact that vaporizing is unnecessary, methane possesses the advantages of lightness and low flash point. One cb. m. of methane is equivalent to about 1 kg. of liquid fuel, but it i computed that in general use it is 30% cheaper. Ther are several methods for converting methane int acetylene. The conversion can be accomplished b passing the glow discharge through it under reduce pressure, by incomplete combustion in oxygen, and b heating. This provides a useful outlet for the methan of coke-oven gas. It is possible to obtain a gas contain ing 10% acetylene, which can be washed out by mean of acetone. The acetylene itself can be converted int benzene by the usual polymerization process, and b hydrogenation it can be converted into benzine. Methan can also be used for the preparation of methyl chlorid chloroform, and carbon tetrachloride by the usu chlorination process.

The ethylene in coke-oven gas, which occurs to th extent of about 2%, may be converted into trichlor and tetrachlor-ethane, which are valuable as solvent Dichlorethane can also be obtained, and by hydrolysi with water under pressure, glycol may be prepare from it (Bahr and Zieler). This is of importance as a anti-freezing substance for use in refrigerators, and i being used increasingly in the preparation of frost *proof dynamite. Also, there are numerous methods o* converting ethylene into other hydrocarbons. Paraffi hydrocarbons and members of the benzene and anthra cene series can be made from it by passing over heate silica gel or other catalysts, or by the action of ultra violet light or the silent electric discharge. The ol method for the synthesis of alcohol from ethylene b the action of sulphuric acid, and hydrolysis of the ethy sulphuric acid formed may yet prove of value.

Research on the catalytic transformation of th simpler hydrocarbons into more complex ones and int other organic compounds is still proceeding, and ther is no doubt that the future will see further uses fo coke-oven gas. A. J. M.

AN ENCYCLOPÆDIA OF CHEMICAL REACTION

Prof. C. A. Jacobson of the West Virginia Universit and a large number of graduate students have bee engaged for more than four years upon the problem o collecting and arranging chemical data in a way whic has never before been attempted. The plan comprise the alphabetical listing under each element of all activ inorganic and a limited number of organic substance and in a marginal space to the left, all substances know *to react with the former, numbered consecutively unde* each element. A brief statement of the condition governing the reaction of the substance with the reagen will be found opposite each number, and following thi a balanced equation, showing by formulæ the product formed. Reference is then given to an original publi cation with author's name and date of publication.

The following examples illustrate the plan :

Iron

$K_4Fe(CN)_6$

No. 424
K_2CO_3

If a mixture of eight parts of potassium ferro cyanide and three parts of potassium carbonate i heated to a glowing temperature, potassium cyanid *and cyanate are obtained.*

$K_4Fe(CN)_6 + K_2CO_3 = 5KCN + KCNO + Fe + CO_2$

J. Liebig. Annalen, Vol. 41, p. 286 (1842).

Lithium

No. 112 $LiC_2H_3O_2$

H_3PO_4 A solution of phosphoric acid *added to a solution* of lithium acetate precipitates trilithium phosphate.

$$3LiC_2H_3O_2 + H_3PO_4 = Li_3PO_4 + (3HC_2H_3O_2)$$

J. J. Berzelius. Pogg. Ann., Vol. 4, p. 245 (1825).

Since the plan is international in scope it will be necessary to secure abstractors for all foreign as well as domestic journals of chemistry that are repositories of authentic chemical data.

It is not certain if the completed work will take the form of bound volumes or card index files, but the original records will be sent on individual cards to a central office, where the tabulations and arranging of the data will be made. A completed work of this sort would not only facilitate chemical research but would also be the means of avoiding costly duplication of investigations. An added advantage would be to inform research workers where and by whom discoveries have been made. The plan is endorsed by many leading chemists. A discussion of the project will be found in the October issue of the *Journal of Chemical Education*, of which reprints will be available from Prof. C. H. Jacobson, West Virginia University, Virginia, U.S.A.

THE FIRST INTERNATIONAL CONGRESS OF GLASS AND CERAMICS

The many interests which ceramists and glass technologists have in common were well brought out at this congress, which was held at Milan and Venice from September 16 to 25. The congress owed its inception and organization to the "Federazione Nationale Fascista dell'Industria del Vetro," and had an imposing list of Italian patrons. The British party of visitors to the congress was organized by the Society of Glass Technology and numbered 32, including 9 representatives of the Ceramic Society and the Refractories Association of Great Britain.

The opening ceremony of the congress took place on Sunday morning, September 17, in the hall of the Fifth Triennial Exhibition of Modern Art, and the delegates of many countries were present. After addresses of welcome from the president, Signor Benjamino Donzelli, and vice-president, Signor Luciano Scotti, greetings were given by delegates from the various countries. Indefatigable interpreters made the proceedings intelligible to everyone. As a further prelude to the serious work of the congress, its members were entertained by their Italian hosts at the "Concorse Internazionale di Eleganza Automobili."

On the following morning serious work began with a joint meeting, after which glass and ceramics were separated. No less than 75 papers were listed to be read and discussed, and the British delegates were responsible for 13 of them. It is perhaps a little ungrateful to criticize the comprehensive organization, but the valiant, yet unsuccessful, efforts of the Italian chairmen to control volubility and keep to a time-table showed the unwisdom of providing such an unwieldy programme. The papers covered the whole field of artistic and technical developments of glass, pottery, and refractories, and a few could have been made the basis of valuable discussions. If this First International Congress is to be the forerunner of others on a similar scale, it would be better to arrange a smaller number of authoritative contributions which should be preprinted in full and adequately discussed.

During the stay in Milan the official banquet was held and there were others sponsored by leading industrial organizations. Two of the largest pottery works in Italy were visited and their up-to-date equipment for mass-production received much favourable comment. The British group also visited a modern glass-bottle plant and a large works making refractories and glazed sanitary ware. The orderly arrangement and scientific control of the latter was especially noteworthy. The Ceramica Lombarda at Lambrate employs the latest methods of mechanical handling. The speed of production is amazing, and left no doubt as to the revitalizing of this branch of Italian industry.

On the evening of September 21 the whole congress moved to Venice and the succeeding two days were employed in sightseeing and visits to glassworks, whilst there was a reception in the Palazzo Ducale and a banquet at the renowned Hotel Danielli. The famed glassworks of Murano are a marvellous mixture of ancient and modern processes. On one side of one works was a log-fired pot-furnace with the glass from which the most delicate ware was fashioned by the same hand methods as brought fame and fortune to Venice, and at the other side were recent types of tank-fed automatic machines rapidly producing glass tubing. At Porto Marghera a large battery of modern coke-ovens was seen coupled to a Libby-Owens plant with huge tank furnaces for the automatic production of plate glass.

The congress tour concluded with visits to the Ceramic School and Museum at Faenza, and the Richard-Ginori Pottery at Florence. The journey home was broken at Modane by a visit to the works of L'Electro Refractaire to see the most recent developments in the production of refractories. Bauxites of controlled composition are fused in large three-phase furnaces, and the molten material cast into sand moulds and annealed in beds of kieselguhr. Finally there was a memorable trip to the summit of Mont Cenis.

From the social standpoint this congress was an unqualified success, and the hospitality of the Italian hosts was nothing less than prodigious. At the closing meeting a suggestion that the second congress should be held in England in 1936 was received with great enthusiasm.

W. J. Rees

CANADIAN MINING

The Dominion Bureau of Statistics reports that the production during the first half of 1933 of platinum, palladium, and other metals of this group from Canadian ores was valued at $344,753, as compared with $1,363,865 for the corresponding period of 1932.

Thirteen Canadian plants manufacturing asbestos products in 1932 had an output valued at $1,067,801, as against $1,308,183 in 1931. The production of gypsum from Canadian deposits last year amounted to 438,629 tons valued at $1,080,379 as compared with 863,752 t. worth $2,111,517 a year previously.

SOCIETY OF CHEMICAL INDUSTRY

OFFICIAL NOTICES

Food Group Symposium. Brief particulars of the programme of the fourteen papers to be discussed at the Symposium, which is to be held in the Hall of the British Medical Association, Tavistock Square, London, W.C.1, on Thursday and Friday, November 23 and 24, will be found in the calendar of forthcoming events in *the advertising pages of this number. The papers,* of which advance copies are available to those intending to be present, will be *presented by the authors in person,* but will only be expounded and not read *in extenso. Each paper will in turn be offered for discussion and the* chairmen will sum up finally at the end of each of the three sessions.

Applications for advance copies should be made in writing to the General Secretary, 46, Finsbury Square, London, E.C.2.

The dinner at the Trocadero Restaurant on Friday, November 24, which is the last item of the Symposium Meeting, is open to all members and others interested in the subjects of the Symposium, bread and milk. Ladies will be specially welcome. Price of tickets, including gratuities and the cabaret entertainment, 10s. 6d., obtainable from the General Secretary.

Annual Chemical Dinner—Final Notice. *Members* are reminded that the Annual Chemical Dinner, which is open to members of all Societies interested in chemistry, will take place at the Hotel Great Central on November 28 under the chairmanship of Lord Leverhulme, and will be followed by dancing.

Applications for tickets must be made by the 21st inst. to Mr. F. A. Greene at the Chemical Club, 2, Whitehall Court, S.W.1, and must be accompanied by the appropriate remittance, 12s. 6d. each person, including gratuities.

***Proposed Subject Group for Constructional* Materials.** This new Group, if formed, will deal with scientific problems concerned with constructional material generally—not only road material, though the idea of its formation originated in the recent Road Materials Conference. All persons interested, within or without the Society, should communicate with Mr. F. M. Potter or with the General Secretary at the Society's Office.

MEMBERS ELECTED

November 10, 1933

Axam, Russell Dudley, No. 217, Willoughby Road South, North Sydney, Australia. Analytical chemist.

Benmon, Edmund Baron, 8, Broadmead Road, Woodford Green, Essex. Head of National Baking School.

Bennett, Thomas Mitchell, c/o Mrs. Willetts, Naini, Alty's Lane, Ormskirk, Lancs. Chemist.

Boughay, Herbert Edwin, 85, Woodland Road, Tyndall's Park, Bristol. Electro chemist.

Graves, *Henry Charles Herbert,* 23, *Upper Mall,* London, W.6. Managing director, Vitamins, Ltd.

Hockin, Leslie Ernest, 12, King's Drive, Bishopston, Bristol. Chemist.

Jones, Walter Idris, Research Dept., Powell Duffryn Steam Coal Co., Ltd., Ystrad Mynach, near Hengoe, Glam, South Wales. Research chemist.

Nicholson, John S., 105, Macfarlane Street, Paisley. Works chemist.

Olsen, Arne Jorgen Carl, c/o The Distillers Co., Ltd., 12, Whitehall, London, S.W.7 Chemical engineer.

Thorp, Hubert William, 92, Queen's Road, Dalston E.8. Chemical engineer.

Turner, Stephen Henry, 12, New Heston Road, Heston, Hounslow, Middlesex. Chemist.

Walsh, James F., Director of Research, American Maize Products Co., Roby, Indiana, U.S.A. Director of Research.

Whitworth, James Bell, The University, Chemical *Laboratory, Cambridge. Assistant, University* Chemical Laboratory, Cambridge.

Wheeler, H. R., 46, Logan Road, Bishopston, Bristol 7. Paper-board maker.

Associate Members

Alexander, G. C., 93, Kingsley Road, Liverpool 8. Student.

Burnett, Robert, 136, Windsor Street, Liverpool 8. Analytical chemist.

Duckworth, Frank, 1, Station Villas, Hellifield, Yorks. Student.

Flynn, Daniel G., 52, Ferndale Road, Liverpool. Student.

Harper, W. Kenneth, c/o Laboratory, British Enka Art Silk Co., Ltd., Aintree. Analyst.

Howes, Percy Edmund, 7, Pretoria Street, Handbridge, Chester. Works chemist.

King, Henry Irving, 20, Birchfield Road, Widnes. Res. student.

Parker, Leslie, 10, Malvern Road, Fairfield, Liverpool 6. *Analytical chemist.*

Quinn, Anthony, 37, South View, Bromboro Pool, Rock *Ferry, Birkenhead. Analytical chemist.*

Rushy, George Leger, 33, Litherland Park, Liverpool. Res. student.

Tristram, George R., Rankin Hall, 44, Ullet Road, Liverpool 17. Student.

LIVERPOOL SECTION

The second meeting of the session was held jointly with the Liverpool and North Western Section of the Institute of Chemistry in the University, Liverpool, on November 9, Mr. J. E. Knowles in the chair.

A lecture was delivered by Prof. Alexander Robertson, professor of organic chemistry at the University of Liverpool, entitled "The Insecticides and Fish Poisons of the Derris Root and Related Substances."

The lecturer mentioned the many problems with which the entomologist had to deal and referred to the ravages of the boll weavil in cotton plantations and of the Colorado beetle among potatoes. In this country alone the damage caused by the warble fly amounted to over £400,000 annually, and in the United States to about $50,000,000.

Prof. Robertson illustrated with lantern slides the cultivation of the Derris Root and the preparation and use of the extract by the natives of the Dutch East Indies, and elsewhere, to catch fish, the extract having a paralyzing effect.

The lecturer proceeded to discuss the chemical nature of the active constituents, rotenone, deguelin, tephrosin, and toxicarol, and gave a most interesting account of lengthy investigations which had led up to the elucidation by syntheses of the exact constitution of these substances. He mentioned that these researches had been forced upon academic chemists by industry.

After some discussion in which Dr. T. Callan, vice-chairman of the Manchester Section of the Society of Chemical Industry, Mr. E. T. Williams and others took part, a cordial vote of thanks was proposed by Mr. E. Gabriel Jones, who also offered Prof. Robertson a welcome to Liverpool on behalf of the local section of the Society. The resolution was seconded by Mr. F. Robertson Dodd and carried with acclamation.

MONTREAL SECTION

Members of the Montreal Section of the Society visited Shawinigan Falls on October 20–21, as guests of the Shawinigan Section and the Shawinigan Chemicals, Ltd. The party, numbering twenty-eight, was welcomed at an informal reception and smoker, at which Mr. R. A. Witherspoon, chairman of the Montreal Section, and Mr. T. W. Smith spoke briefly on behalf of the visitors.

On the following morning, the party visited the plant of the Shawinigan Water & Power Co., and were conducted through the power house by various members of the staff of that company, whilst the machines were in operation at full capacity. Special features of the five horizontal 14,000-kw. machines, and the three vertical 33,000-kw. machines were explained to the members, as well as the intricate control system of the plant. The visitors then proceeded to the chemicals division of the Shawinigan Chemicals, Ltd. and saw the various departments of the factory engaged in the manufacture of acetic acid, acetaldehyde, and derivatives from acetylene. The plant presented a busy picture, operating at full capacity. A special system of flooding automatically with water in case of fire or explosion was followed with interest. An interesting feature was the steam-generating plant, consisting of three 5000-kw. electric steam generators, the coal-fired system being kept in reserve. The extensive ammonia refrigeration system, with the most modern type of two-stage compressors, was also inspected. The visitors were also shown how the polyvinyl acetate plastics "Gelva" and "Alvar" were produced, and were surprised to learn of the variety and attractiveness of the products that can be made from these materials.

The group next visited the carbide plant, where the operation of the carbide furnaces, some of which are as large as 15,000 kw., was explained, and members were able to see the tapping of one of these furnaces. The large rotary lime kilns burning powdered coal were inspected, and also the briquetting plant for producing briquettes of hydrated lime and of coke.

At the conclusion of the inspections the visitors were again entertained to lunch, when Mr. Witherspoon expressed deep appreciation of the efforts that had been made by the Shawinigan Section to make the visit such a success, and remarked on the atmosphere of complete informality which had helped so much to make the occasion a very happy one. Mr. Williams responded for the Shawinigan Section.

OTTAWA SECTION

On November 1 the Ottawa Section of the Society, together with parties of students from McGill University, Montreal, and from Ashbury College, Ottawa, made a tour of inspection of the plant of Courtaulds, Ltd., and of the Howard Smith Paper Mill at Cornwall, Ontario. Mr. F. W. Elliott welcomed the visitors on behalf of the Howard Smith Co. The party proceeded to the eastern limits of the city, where the rayon mill is located and were shown the various steps in the process from the raw material to the finished product and were greatly impressed by all they saw.

At the paper mill, the visitors were shown the methods of putting special finish on paper, the soda process at work, the recovery of alkali from waste, the chlorination plant, and the sulphite mill. The Section was much indebted to both firms for their kindness in providing so efficiently for the success of the excursion.

PERSONAL AND OTHER ITEMS

The council of the University of Sheffield has appointed Mr. W. C. Hancock, of the Imperial College, London, to be external examiner of theses for the Ph.D. degree in refractories. Mr. W. J. Mitchell has been appointed junior research assistant in glass technology in the University, and Mr. H. Laithwaite has been appointed Research Fellow in glass technology.

Mr. W. J. Holland, a director of I. G. Farbenindustrie, A.-G., recently retired from business after having been connected with the dyestuffs industry for 50 years. Mr. Holland was the manager, before the war, of the Bradford office of Meister, Lucius & Brüning, and resumed his connexion with the German company after the war. He became a director of I. G. Farbenindustrie A.-G., when the combine was formed in 1926.

Prof. H. G. Greenish, late professor of pharmaceutics in the University of London, left estate of the gross value of £4291, with net personalty £1217.

Testing of Road Materials Conference

Dr. J. T. Dunn presided at a luncheon arranged jointly by the Society's Chemical Engineering Group, Plastics Group, and London Section, following the morning session of the Conference, on Tuesday, November 14. A toast of "The Foreign Visitors" was proposed by Dr. Dunn and responded to by M. Le Gavrian, French Inspector-General of Roads.

Among other distinguished visitors were MM. J. Boulloche and J. Bing of the French Ministry of Roads, Prof. Dr.-Ing. Neumann of Stuttgart, Dr.-Ing. Loman, Dutch Ministry of Roads, Prof. G. T. Morgan, Dr. R. E. Stradling, Prof. R. Clements (who occupies the only British Chair of Highways Construction), and Messrs. E. J. Elford, H. V. Potter, H. E. Cox, W. G. Adam, R. G. Clarry, H. T. Chapman, J. Arthur Reavell, A. Lowe, and H. J. Pooley.

The Poisons Board

The Home Secretary announces that he has appointed Sir Gerald Bellhouse, C.B.E., to be chairman of the Poisons Board established under section 16 of the *Pharmacy and Poisons Act*, 1933, and that the Board has now been constituted as follows (the appointing authorities are given in parentheses): Sir Gerald Bellhouse (chairman), Sir Walter Greaves-Lord, Sir William Lobjoit, and Mr. M. H. Whitelegge (Home Secretary); Mr. J. M. Johnston (Secretary of State for Scotland); Mr. J. N. Beckett and Dr. G. F. McCleary (Minister of Health); Mr. H. E. Dale (Minister of Agriculture and Fisheries); Sir Robert Robertson (*ex officio* as Government Chemist); Mr. J. H. Franklin,

Mr. H. N. Linstead, Mr. G. A. Mallinson, Mr. E. T. Neathercoat, and Mr. P. Sparks (Pharmaceutical Society of Great Britain); Sir William H. Willcox (Royal College of Physicians of London), Mr. R. Stockman (Royal College of Physicians of Edinburgh); Mr. S. A. Smith (General Medical Council), Mr. G. Roche Lynch (Council of the Institute of Chemistry); Dr. J. W. Bone (British Medical Association).

The duties of the Board are to prepare for the approval of the Secretary of State a list of the substances which are to be treated as poisons for the purposes of the Act, and generally to advise the Secretary of State in regard to the rules to be made for the control of poisons.

The Nobel Prize in Physics

The Nobel Prize in Physics for 1933 has been awarded jointly to Prof. P. H. M. Dirac of the University of Cambridge, and Dr. E. G. Schrödinger of Magdalen College, Oxford, for having furthered a new and fruitful development of the theory of the atom. Both physicists have been concerned with work on quantum mechanics and following Shrödinger's wave-mechanical interpretation, Dirac was able to develop a theory which predicted the existence of positive electrons. The Nobel Prize in Chemistry for 1933 has been reserved.

Beit Fellowships for Scientific Research

It is announced that the next election of Beit Scientific Research Fellows will take place on or about July 13, 1934, when not more than three Fellowships will be awarded. Applications must be forwarded not later than April 12, 1933, to the Rector, Imperial College, South Kensington, London, S.W., from whom also application forms and all information may be obtained.

The Fellowships are tenable for two years and are of the annual value of £250. Candidates must be under 25 years of age and must have taken a degree at an approved University or passed another examination approved by the Trustees of the Fellowships.

University College of Hull

The University College of Hull has instituted a diploma in aeronautics which combines a theoretical course of study with practical engineering training. Lord Wakefield has made a gift of £1500 to enable the University College to appoint a lecturer for an experimental period of three years. The theoretical course will start in October, 1934.

Reform of the Chilean Nitrate Industry

The Chilean Chamber has approved the main lines of the plan to reform the Chilean nitrate industry. By this plan the monopoly of the sales of nitrate belong to the State, which may cede it or hire it out for a maximum of 35 years to a selling organization. For sales up to 1,000,000 metric tons each year 90% will be obtained by fresh production and 10% will be taken from existing stocks. For sales in excess of 1,000,000 t. 25% will be taken from stock and the remaining 75% obtained by fresh production. The State's participation in profits from sales will be on a sliding scale between 25% and 40% accordingly as sales range between 800,000 and 1,500,000 t., whilst profits from the sales of existing stocks are to be paid to the original creditors of the nitrate industry before the formation of the Cosach combine. These creditors are known as "the beneficiaries of the Ramirez plan."

REVIEWS

INFRA-RED PHOTOGRAPHY. By S. O. Rawling, D.Sc. Pp. x + 57. London and Glasgow: Blackie & Son, Ltd. 1933. 3s. 6d.

Infra-red photography is more than thirty years old, but only during the last three years has it attained any commercial importance. This book, which is well written and well illustrated, gives the instruction necessary to those who wish to practise infra-red photography at the present time, and the price is so low that no one who is interested in this art should be deterred by it.

REPORT OF THE NATIONAL PHYSICAL LABORATORY FOR THE YEAR 1932. Pp. vi + 277. London: H.M. Stationery Office, 1933. 14s.

This report is a substantial scientific document in which researches and services carried out in all departments of the National Physical Laboratory during 1932 are described. The apparatus or results are in many cases displayed by means of plates or figures, and the volume is indexed. Inevitably reference has to be made to the effect of the serious financial difficulties of the year; severe trade depression led as its direct result to a reduction in the number of special investigations carried out for industrial firms and other bodies, and to a diminution in the number of routine tests of instruments. In a short review only the briefest reference to a few of the numerous investigations of interest to industrial chemists is possible. For example, the Physics Department is working on the thermal and electrical conductivities of alloys at high temperatures; the thermal conductivities of the alloys examined tend towards a common value at about 1000°. Work is in progress with a view to increasing the accuracy of thermocouple measurements by improvement in the methods of construction and the use of potentiometers of greater accuracy and sensitivity. In connexion with food investigation studies on heat transmission, evaporation from wet surfaces, and the thermal properties of foodstuffs have been undertaken, and further work has been done on the application of *X*-ray crystal analysis to industrial problems. The Electricity Department has been concerned, *inter alia*, with the problem as to whether there is any electrochemical effect between water and the lead of a pipe in which it flows. The Engineering Department has continued studies on corrosion fatigue and on the mechanical properties of materials at high temperatures, whilst the Metallurgy Department has in hand problems such as the constitution of the iron-manganese system, the age-hardening of aluminium alloys, the preparation of magnesium alloys, and numerous special researches. A. A. E.

SPARKS FROM THE ELECTRODE. By C. L. Mantell, Ph.D. A Century of Progress Series. Pp. x + 127. Baltimore: Williams & Wilkins Co.: London: Baillière Tindall & Cox. 1933. 5s.

This little book is brightly written and gives a popular account of the progress of many industries especially, but by no means exclusively, the American progress. Those interested in the history of the chemical industry will find many useful facts, some of which the average man in Great Britain would only learn by a long search. It is a book that is easy and pleasant to read.

COMPANY NEWS

BRITISH CELANESE, LTD.

The 14th general meeting of the company was held on November 9, when the chairman, Dr. H. Dreyfus, said that a considerable improvement in trading had taken place in the current year, and the volume of business was larger than at any time in the company's history; profits for the first four months of the year were in excess of the total profits of last year. (Cf. CHEM. & IND., Nov. 3, for financial results of year ended July 1.)

Referring to the allocation of £108,215 to research and advertising, the chairman said that the development of new products and improvements which had been made were the result of research work, which would therefore influence the company's future prosperity. Amongst the new products was "Celanese Blanche Yarn," which possessed a natural dulness, the trend of fashion being away from brightness toward dulness. Celanese artificial wool would be marketed under a new trade name; the plant for making transparent paper and similar articles was ready, and it was hoped to market these articles in the course of the next month or two.

ASSOCIATED DYERS & CLEANERS, LTD.

The directors of the company state that the course of trading throughout the current year does not justify them in paying the dividend on the 6½% cumulative preference shares for the half-year ended October 31. The dividend on these shares is in arrear from May 1, 1932.

STANTON IRONWORKS CO., LTD.

The company has announced an interim dividend of 4% actual on the ordinary shares. This is at the same rate as last year's interim dividend on the issued capital of £1,552,794.

E. I. DU PONT DE NEMOURS & CO.

A preliminary statement by the company shows earnings of 95 cents per share for the three months ended September 30, 1933. This compares with 68 cents per share in the preceding quarter, and 36 cents in the corresponding quarter last year.

BROWN BAYLEY'S STEEL WORKS, LTD.

The profit of the company for the year ended August 5 was £2251 as compared with a loss of £3140 last year. No payment is yet to be made on the preference shares, the last dividend on which was paid in January, 1929.

IMPERIAL SMELTING CORPORATION, LTD.

The net profit of the company for the year ended June 30, 1933, was £129,880, as compared with £137,472 last year. The company operates works at Swansea and Avonmouth through subsidiaries, and has interests in several companies mining and melting lead, zinc, and silver in Burma, Australia, and elsewhere. Operations at both the Swansea and Avonmouth works continue to expand, and production is at a greater rate than a year ago. A subsidiary, Improved Metallurgy, Ltd., has been formed to erect a vertical retort zinc distillation and refining plant at Avonmouth, and it is anticipated that this plant will be in full operation within a year.

MARKET REPORT

This Market Report is compiled from special information received from the manufacturers concerned.

Unless otherwise stated, the prices quoted below cover fair quantities net and naked at sellers' works.

The following alterations in prices are reported since the publication of the last Market Report (cf. CHEM. & IND., Nov. 3, 1933, p. 890).

RUBBER CHEMICALS

Cadmium Sulphide.—2s. 7d.–2s. 11d. per lb.

Carbon Black.—3½d.–5d. per lb., ex wharf.

Sulphur.—£11 per ton. Sulphur Precip. B.P.—£55—£60 per ton. Sulphur Precip. Comm.—£50—£55 per ton.

TAR PRODUCTS

Naphtha.—Solvent, 90/160, 1s. 4d.–1s. 5d. per gal. Solvent, 95/160, 1s. 8d.–1s. 9d. per gal. Solvent 90/190, 11d.–1s. 1d. per gal.

Pyridine.—90/140.—5s.–5s. 6d. per gal., 90/180—2s.—2s. 3d. per gal.

Toluole.—90%, 2s. 7d.–2s. 8d. per gal. Pure, 3s. 3d. per gal.

Xylol.—2s. 9d.–2s. 10d. per gal. Pure, 3s.

PHARMACEUTICAL AND PHOTOGRAPHIC MATERIALS

Bismuth Salts.—Carbonate, 7s. 8d. per lb.; Citrate, 10s. 3d. per lb.; Nitrate (cryst.), 5s. 4d. per lb.; Oxide, 12s. per lb.; Salicylate, 8s. 7d. per lb.; Subchloride, 11s. 8d. per lb.; Subgallate, 8s. 2d. per lb.; Subnitrate, 6s. 9d. per lb. Above for cwt. lots. Extra and reduced prices for smaller and larger quantities respectively. *Liquor Bismuthi*, P.P., in W. Qts.—1s. 1½d. per lb.; 6 W. Qts.—11d. per lb.; 12 W. Qts.—9½d. per lb.; 36 W. Qts.—9d. per lb.

PATENT LIST

The following is a list of complete specifications of chemical interest which are open for inspection under Section 91 (4) (a) of the Patent Acts. Printed copies are not available, but photographic copies may be obtained at a charge of 8d. per page (minimum 1s.) from the Patent Office, Chancery Lane, W.C.2

I. 7868 (1933). Soc. Anon. le Carbone. Treatment of gases and vapours.

9207 (1933). Mathieson Alkali Works. *See* VII.

10,454 (1933). Foster Wheeler, Ltd. Pulverizing apparatus.

II. 7868 (1933). Soc. Anon. le Carbone. *See* I.

III. 12,412 and 12,646 (1933). I. G. Farbenind. Manufacture of acetyl chloride.

12,631 (1933). I. G. Farbenind. *See* IV.

IV. 12,092 (1933). I. G. Farbenind. Manufacture of azo dyestuffs.

12,308—9 (1933). Du Pont de Nemours & Co. Manufacture of sulphur dyestuffs.

12,627 (1933). Du Pont de Nemours & Co. *See* VI.

12,631 (1933). I. G. Farbenind. Manufacture of dyestuffs and intermediate products.

V. 12,394 (1933). Brit. Celanese, Ltd. Reducing the permeability of articles and materials.

VI. 12,187 (1933). Erba Fabr. Chem. Prod. Increasing the moistening power of mercerizing solutions.

12,394 (1933). Brit. Celanese, Ltd. *See* V.

12,627 (1933). Du Pont de Nemours & Co. Production of dyes on the fibre.

VII. 17,463 (1932). Amer. Cyanamid Co. Preparing stable granluated calcium cyanamide.

9207 (1933). Mathieson Alkali Works. Chemical manufacture.

VIII. 11,562–3 (1933). Harkort. Production of lead glazes.

X. 10,703 (1933). I. G. Farbenind. Casting of magnesium and its alloys.

12,298 (1933). Brit. Thomson-Houston Co. Obtaining pure cobalt in powder.

XI. 10,594 (1933). Electric Furnace Co. Electric induction furnaces.

XIII. 12,155 (1933). Brit. Celanese, Ltd. Synthetic resins and compositions containing them.

12,181 (1933). Soc. Chem. Ind. in Basle. Manufacture of artificial masses.

XVI. 11,955–6 (1933). I. G. Farbenind. *See* XXIII.

XX. 9620 (1933). Soc. Chem. Ind. in Basle. Purifying the hormone of the corpus luteum.

XXI. 12,182 (1933). I. G. Farbenind. Sensitization of photographic emulsions.

12,192 (1933). Klemer. Production and reproduction of pictures or designs by means of visible or invisible rays.

12,630 (1933). I. G. Farbenind. Photographic printing.

XXIII. 11,955–6 (1933). I. G. Farbenind. Agents for combating insects.

GENERAL NOTES

Official Trade Intelligence

The Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, has received the following inquiries for British goods. British firms may obtain further information by applying to the Department and stating the specific number. *Argentina:* Nitro-cellulose paint (528). *British West Indies, Trinidad:* Vegetable tanning materials and extracts (500). *Holland:* Fish-plates and sole-plates, steel (519). *Malta:* Soap (507). *Newfoundland:* Linseed oil (508).

Glycine B.D.H.

Interest has been aroused recently by the successful results obtained in using glycine (aminoacetic acid) by oral administration for the treatment of muscular dystrophy. The British Drug Houses, Ltd. has been making this simple amino acid for some time for chemical use in a degree of purity that makes it ideal for medicinal purposes, and the company is in a position to meet the heavy demand that has arisen for the material. The company will be pleased to send samples and information concerning Glycine B.D.H. to anyone who may be interested.

Surface Treatment of Aluminium

For some years engineers have been endeavouring to improve the corrosion resistance of aluminium, particularly with regard to its performance in contact with salt solutions. Bauer and Vogel in 1916 described a coating process based on treatment for 2 to 4 hours with a hot solution of potassium carbonate, sodium bicarbonate, and potassium bicarbonate, and in 1923 patented an improved process which decreased the time of treatment. During 1930 Dr. Gustav Eckert studied this process and modified it to such an extent that a protective coating could be produced in 3 to 5 minutes. The process has been patented and as the "B.M.V. process" is used extensively on the Continent. An excellent booklet has recently been published by The British Aluminium Co., Ltd., Adelaide House, King William Street, London, E.C.4, describing the process and its applications. The booklet is a translation of the essay submitted by Dr. Eckert in the 1932 International Aluminium Competition, and gives a good deal of useful information.

New I.C.I. Dyestuffs

Imperial Chemical Industries, Ltd. has added *Naphthalene Leather Brown RBS* to its range of acid dyestuffs for application to leather. When dyed in the customary manner, *i.e.*, with an addition of sulphuric acid or formic acid to the dye bath, it gives maroon brown shades of exceptional strength on all classes of leather. Its good solubility makes it suitable for brush staining of hides for upholstery work, and its good fastness to light will make it of interest to the gloving and book-binding trades. Apart from its use as a self shade, the new dyestuff will find extensive application with acid and Chlorazol dyes to give full and dark brown colours.

Another addition to the I.C.I. range of colours is Monolite Bordeaux BLYS, a yellow shade of the well-known Monolite Bordeaux BLS, possessing similar fastness properties. It will be of particular interest in the manufacture of printing inks, oil and water paints, and colours for linoleum, wallpaper, and paper surfacing. It is obtainable in the paste and powder forms.

Import Duties Advisory Committee

The Import Duties Advisory Committee gives notice of applications for drawback under Section 9 of the Finance Act, 1932, in the case of graphite crucibles, and muffle rings, stands, stirrers, and covers in respect of the natural flake graphite used in their manufacture. Representations in regard to these applications should be addressed in writing to The Secretary, Import Duties Advisory Committee, Caxton House, Tothill Street, London, S.W.1, not later than December 4, 1933.

PUBLICATIONS RECEIVED

Reprint of Three Lectures Embodying "A Survey of Modern Inorganic Chemistry." By G. T. Morgan, O.B.E., D.Sc., F.R.S. Pp. 106. London: Institute of Chemistry of Great Britain and Ireland, 1933.

Origin of Living Matter. By Dr. H. A. Gray and N. M. Bligh. Pp. 26. Cambridge: W. Heffer & Sons, Ltd., 1933. 1s. 6d.

Introduction to Physical Chemistry. By A. Findlay. Pp. vii + 492. London: Longmans, Green & Co., 1933. 7s. 6d.

Standard Methods of Analysis: Of Iron, Steel, and Ferro-Alloys. Pp. 36. Sheffield: The United Steel Companies, Ltd., 1933. 4s. 6d.

Fluorescence Analysis in Ultra-Violet Light. By J. A. Radley, B.Sc., A.I.C., and J. Grant, Ph.D., M.Sc., F.I.C. Series of Monographs on Applied Chemistry. Vol. VII. Edited by E. H. Tripp, Ph.D. Pp. xi + 219. London: Chapman & Hall, Ltd., 1933. 15s.

Organic and Bio-chemistry. By R. H. A. Plimmer, D.Sc. 5th ed. Pp. x + 624. London: Longmans, Green & Co., 1933. 21s.